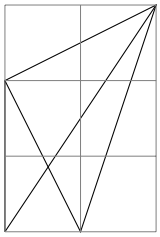
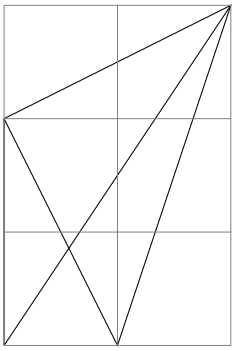
1 SIMPLE STRAIGHT LINES

```
\begin{tikzpicture}
        \draw (0,0) -- (1,2);
\end{tikzpicture}
```

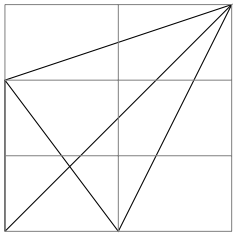


```
\begin{tikzpicture}
        \draw (0,0) -- (0,2) -- (2,3) -- (1,0) -- (0, 2);
        \draw (0,0) -- (2,3);
        \draw[help lines] (0, 0) grid (2, 3);
\end{tikzpicture}
```

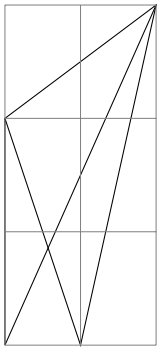
2 SCALING PICTURES



```
\begin{tikzpicture}[scale = 1.5]
        \draw (0,0) -- (0,2) -- (2,3) -- (1,0) -- (0, 2);
        \draw (0,0) -- (2,3);
        \draw[help lines] (0, 0) grid (2, 3);
\end{tikzpicture}
```

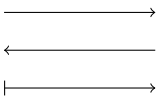


```
\begin{tikzpicture}[xscale = 1.5]
        \draw (0,0) -- (0,2) -- (2,3) -- (1,0) -- (0, 2);
        \draw (0,0) -- (2,3);
        \draw[help lines] (0, 0) grid (2, 3);
\end{tikzpicture}
```

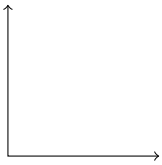


```
\begin{tikzpicture}[yscale = 1.5]
        \draw (0,0) -- (0,2) -- (2,3) -- (1,0) -- (0, 2);
        \draw (0,0) -- (2,3);
        \draw[help lines] (0, 0) grid (2, 3);
\end{tikzpicture}
```

3 ARROWS

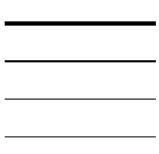


```
\begin{tikzpicture}
\draw [->] (0,0) -- (2, 0);
\draw [<-] (0, -0.5) -- (2,-0.5);
\draw [|->] (0,-1) -- (2,-1);
\end{tikzpicture}
```



```
\begin{tikzpicture}
\draw [<->] (2, 0) -- (0,0) -- (0,2);
\end{tikzpicture}
```

4 CHANGING THICKNESS



```
\begin{tikzpicture}
```

```
\draw [ultra thick] (0,1) -- (2, 1);
\draw [thick] (0,0.5) -- (2,0.5);
\draw [thin] (0,0) -- (2,0);
\draw [ultra thin] (0, -0.5) -- (2, -0.5);
\end{tikzpicture}
```

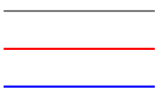
Full options include ultra thin, very thin, thin, semithick, thick, very thick, and ultra. Custom widths can also be used.

```
\begin{tikzpicture}
\draw [line width = 12] (0, 0) -- (2,2);
\draw [line width = 0.2 cm] (4, 0.75) -- (5, 0.25);
\end{tikzpicture}
```

5 DASHES AND DOTS

```
\begin{tikzpicture}
\draw [dashed, ultra thick] (0,1) -- (2,1);
\draw [dashed] (0,0.5) -- (2,0.5);
\draw [dotted] (0,0) -- (2,0);
\end{tikzpicture}
```

6 COLORS



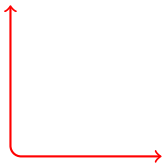
```
\begin{tikzpicture}
\draw [gray, thick] (0,1) -- (2, 1);
\draw [red, thick] (0,0.5) -- (2, 0.5);
\draw [blue, thick] (0,0) -- (2, 0);
\end{tikzpicture}
```

Other colors include red green yellow blue cyan magenta black gray darkgray lightgray brown lime olive orange pink purple teal violet white

```
\tikz{\draw [<color>, line width = 6] (0,0) -- (0.5, 0);}
```

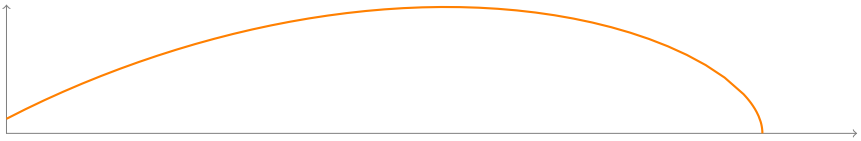
```
\begin{tikzpicture}
\draw [blue] (0,0) rectangle (2,1);
\draw [red, ultra thick] (3, 0.5) circle [radius = 0.5];
\draw [green, thick] (5.5,0.25) arc [radius = 1, start angle = 45,
    end angle = 135];
\end{tikzpicture}
```

Arc of radius 1 starts at the point (6,0), leaves it at an angle of 45 degrees and stops when its slope is 135 degrees. To make paths take smoother turns,



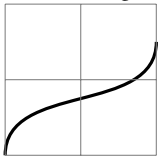
```
\begin{tikzpicture}
\draw [<->, rounded corners, thick, red] (0,2) -- (0,0) -- (2,0);
\end{tikzpicture}
```

Lots of anchor points can be specified explicitly to make a smoother curve.



```
\begin{tikzpicture}[xscale=25,yscale=5]
\draw [<->, help lines] (0.6,1.34) -- (0.6,1) -- (1.05,1);
\draw[orange, thick] (0.6, 1.0385) --
(0.61, 1.06372) -- (0.62, 1.08756) -- (0.63, 1.11012) --
(0.64,1.13147) -- (0.65, 1.15166) -- (0.66, 1.17074) --
(0.67, 1.18874) -- (0.68,1.20568) -- (0.69, 1.22157) --
[... lots of points ...]
(0.9991, 1.03042) -- (0.9992, 1.02866) -- (0.9993,1.02679) --
(0.9994, 1.02478) -- (0.9995, 1.0226) -- (0.9996, 1.02019) --
(0.9997,1.01747) -- (0.9998, 1.01424) -- (0.9999, 1.01005) --
(0.9999,1.01005) -- (0.99991, 1.00953) -- (0.99992, 1.00898) --
(0.99993,1.0084) -- (0.99994, 1.00778) -- (0.99995, 1.0071) --
(0.99996,1.00634) -- (0.99997, 1.00549) -- (0.99998, 1.00448) --
(0.99999, 1.00317) -- (1,1) ;
\end{tikzpicture}
```

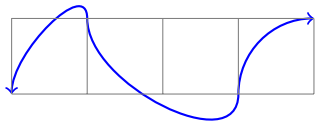
A simpler way to draw a curve is to specify the inlet and exit points, and the inlet and exit angles.



```
\begin{tikzpicture}
\draw[very thick] (0,0) to [out=90,in=195] (2,1.5);
\draw[gray] (0,0) grid (2,2);
\end{tikzpicture}
```

To decipher the angles,

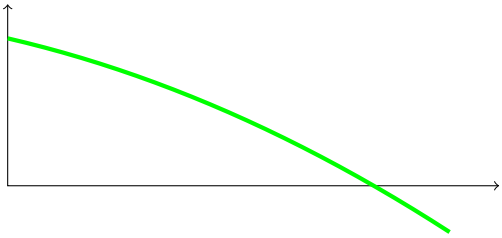
- Draw a vector at the beginning, (0,0) pointing *right* along the base of the figure. Rotate the vector *counterclockwise* until it is tangent with the drawn curve. The angle turned is the `out` angle.
- Draw a vector at the end, (2, 1.5) pointing to the *left* parallel to the base of the figure. Rotate the vector *counterclockwise* until it is tangent with the drawn curve. The angle turned is the `in` angle.



```
\begin{tikzpicture}
\draw [<->, thick, blue] (0,0) to [out = 90, in = 90] (1,1) [out =
    -90, in = -90] to (3,0) to [out = 90, in = 180] (4,1);
\draw [gray] (0,0) grid (4,1);
\end{tikzpicture}
```

8 PLOTTING FUNCTIONS

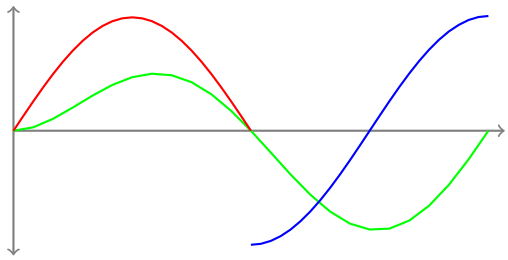
Ti*k*z has a math engine to plot functions.



```
\begin{tikzpicture}[xscale = 13, yscale = 3]
\draw [<->] (0, 0.8) -- (0,0) -- (0.5, 0);
\draw [green, ultra thick, domain = 0:0.45]
plot (\x, {0.65 - \x - 2*\x*\x});
\end{tikzpicture}
```

Available functions include `factorial(\x)`, `sqrt(\x)`, `pow(\x,y)` (x^y), `exp(\x)`, `ln(\x)`, `log10(\x)`, `log2(\x)`, `abs(\x)`, `mod(\x,y)`, `round(\x)`, `floor(\x)`, `ceil(\x)`, `sin(\x)`, (`sin(\x r)` for radians), `cos(\x)`, `cos(\x r)`, `tan(\x)`, `tan(\x r)`, `min(\x, y)`, `max(\x, y)`.

These functions can be mixed together, along with two provided constants, `e` = 2.718281828, and `pi` = 3.141592654.



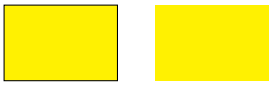
```
\begin{tikzpicture}[yscale=1.5]
\draw [gray, thick, ->] (0,0) -- (6.5,0);
\draw [gray, thick, <->] (0,-1.1) -- (0,1.1);
\draw [green,domain=0:2*pi] plot (\x, {(sin(\x r)* ln(\x+1))/2});
\draw [red,domain=0:pi] plot (\x, {sin(\x r)});
\draw [blue, domain=pi:2*pi]
plot (\x, {cos(\x r)*exp(\x/exp(2*pi))});
\end{tikzpicture}
```

9 FILLING AREAS

Closed paths can be filled.

```
\begin{tikzpicture}
\draw [fill = red, ultra thick] (0,0) rectangle (1,1);
\draw [fill = red, ultra thick, red] (2,0) rectangle (3,1);
\draw [blue, fill = blue] (4,0) -- (5,1) -- (4.75, 0.15) -- (4,0);
\draw [fill] (7, 0.5) circle [radius = 0.1];
\draw [fill = orange] (9,0) rectangle (11,1);
\draw [fill = white] (9.25, 0.25) rectangle (10, 1.5);
\end{tikzpicture}
```

To suppress the outline, replace the `\draw` command with the `\path` command.



```
\begin{tikzpicture}
\draw [fill = yellow] (0,0) rectangle (1.5,1);
\path [fill = yellow] (2,0) rectangle (3.5,1);
\end{tikzpicture}
```